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Review

Chilling injury in peach and nectarine

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Abstract

Peaches and nectarines ripen and deteriorate quickly at ambient temperature. Cold storage is used to slow these processes and decay development. However, low temperature disorders, chilling injury classified as internal breakdown, limit the storage life of peaches and nectarines under refrigeration. The onset of chilling injury symptoms determines the postharvest storage/shipping potential because their development reduces consumer acceptance. Chilling injury is genetically influenced and triggered by a combination of storage temperature and storage period. It manifests itself as fruit that are dry and have a mealy or woolly texture (mealiness or woolliness), or hard textured fruit with no juice (leatheriness), fruit with flesh or pit cavity browning (internal browning), or with flesh bleeding (internal reddening). In this review, we describe what is known about the etiology of each of these types of chilling injury symptoms as well as the biochemical processes in the fruit tissue responsible for their development. We also report on pre- and postharvest manipulations or treatments that can affect the time of appearance or severity of chilling injury symptoms.

Keywords: *Prunus persica* L.; Storage; Physiological disorders; Internal browning; Flesh browning; Internal reddening; Leatheriness; Mealiness; Woolliness

Contents

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1. Introduction

Peaches [*Prunus persica* (L.) Batsch] and nectarines [*P. persica* (L.) Batsch, var. nectarina] belong to the Rosaceae family and are thought to have originated in China (Salunkhe and Desai, 1984). Chinese literature dates cultivation of the peach in China to 1000 B.C. and it was probably carried from China to Persia. Peach, at one time called "Persian apple", quickly spread from there to Europe. In the 16th century, it was established in Mexico and in the 18th century Spanish missionaries introduced the peach to California, which turned out to be the most important production area after China and Italy (LaRue, 1989).

Like other stonefruit, peaches and nectarines, both closely related (Brady, 1993), have a characteristic, lignified endocarp (pit or stone) that encloses the seed, a fleshy mesocarp and a thin exocarp. However, nectarine cells have smaller intercellular spaces than peaches and are, therefore, denser. In addition, they lack pubescence on the skin, which is controlled by a single gene (Lill et al., 1989). On the basis of the separation of the stone from the flesh, peaches and nectarines can be divided into two groups: freestone and clingstone. In addition, based on the amount of softening of the flesh that occurs during ripening, peaches and nectarines can be either of a melting or non-melting type. Melting fruit will soften to below 8N firmness, while non-melting fleshed fruit will soften to 16N or higher. Polygalacturonase (PG) activity has been reported to be different between these two peach types (Lester et al., 1996). Most cultivars have yellow flesh, but white-fleshed cultivars have always been known and are being increasingly planted and currently are 30% of the plantings of the yellow flesh cultivars. The peel of both types may be highly colored due to the accumulation of anthocyanin. Peaches and nectarines with low, medium or high acid concentrations are also available (Genard et al., 1999). Peach fruit is rich in ascorbic acid (vitamin C), carotenoids (provitamin A), and phenolic compounds that are good sources of antioxidants (Tomás-Barberán et al., 2001; Byrne, 2002).

Currently, world production of peaches and nectarines stands at 11 million tonnes, with the three major producing countries being China, Italy and the United States in the Northern hemisphere and Chile, South Africa and Australia in the Southern hemisphere. All of these different combinations of fruit types – peach or nectarine, clingstone or freestone, yellow or white flesh, low, medium or high acidity – are available as freshly harvested fruit from April through September in the Northern Hemisphere and from November to March in the Southern Hemisphere.

Peaches and nectarines ripen and deteriorate quickly at ambient temperature. Therefore, cold storage is used to slow these processes and decay development. However, chilling injury (CI) limits the storage life of peaches and nectarines under low temperature. It has been widely reported that the expression of CI symptoms, especially flesh browning or internal browning, develops faster and more intensely when susceptible fruit are stored at temperatures between 2.2 and 7.6 °C (killing temperature zone) than those stored at 0 °C or below but above their freezing point (Harding and Haller, 1934; Smith, 1934; Crisosto et al., 1999a). These symptoms mainly develop during fruit ripening after cold storage, and the problem is not noticed until the fruit reaches customers (Bruhn et al., 1991; Crisosto et al., 1995). Therefore, fruit maximum storage life can be achieved near or below 0 °C, depending on the soluble solids content of the fruit.